

REMARKS

The application has been amended and is believed to be in condition for allowance.

The previously pending claims have been amended with claims 2 and 4-5 having been canceled.

The present invention can provide a slurry for CMP capable of polishing copper-based metal film at a high polishing rate and of preventing dishing from occurring (Table 1, Figure 1 and claim 1).

The slurry for CMP comprises:

a silica polishing material;

an oxidizing agent;

glycine;

a triazole-based compound which is one of 1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives; and

water, wherein

the content ratio of glycine to the triazole-based compound (glycine/triazole-based compound (weight ratio) is 5 to 8;

the content of the triazole-based compound is not less than 0.05% by weight but not greater than 0.5% by weight; and

the pH value of the slurry is in a range of 5 to 7.

The invention, as now recited, is believed both patentable and non-obvious over the prior art and specifically over the applied references.

Claims 1 and 3-6 were rejected as anticipated by or, in the alternative, as obvious over WANG et al. 2003/0166337 ('337).

Claims 2 and 6 were rejected as obvious over WANG et al.

Claims 1-2 and 4-6 were rejected as anticipated by or, in the alternative, as obvious over TSAI et al. 6,524,167 ('167).

Claims 3 and 6 were rejected as obvious over TSAI et al. in view of WANG et al.

Claims 1-2 and 4-6 were rejected as anticipated by or, in the alternative, as obvious over SAKAI et al. 6,440,186 ('186).

Claim 3 was rejected as obvious over SAKAI et al. in view of WANG et al.

Claims 1-2 and 4-6 were rejected as anticipated by or, in the alternative, as obvious over ASANO et al. 6,679,929 ('929).

Claim 3 was rejected as obvious over ASANO et al. in view of WANG et al.

Claims 1-2 and 4-5 were rejected as anticipated by or, in the alternative, as obvious over SINHA et al. 6,551,935 ('935).

Claims 3 and 6 were rejected as obvious over SINHA et al. in view of WANG et al.

Claims 1-2 and 4-5 were rejected as anticipated by or, in the alternative, as obvious over Taiwanese Patent No. 455626.

Claims 3 and 6 were rejected as obvious over Taiwanese Patent No. 455626 in view of WANG et al.

Claims 1 and 4-6 were rejected as anticipated by or, in the alternative, as obvious over KAUFMAN et al. 6,593,239 ('239).

Claims 1 and 4-6 were rejected as anticipated by or, in the alternative, as obvious over KAUFMAN et al. 6,063,306 ('306).

Claims 2-3 and 6 were rejected as obvious over either KAUFMAN et al. ('239) or KAUFMAN et al. ('306), both in view of WANG et al.

WANG et al. teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, WANG et al. do not disclose glycine as an alpha-amino acid preferable to the polishing composition. Furthermore, Example 1 of WANG et al. teaches that "glycine" is inferior to "alanine" in the performance comparison of dishing and erosion. WANG et al. exclude glycine in which R1 and R2 are both hydrogen.

In addition, WANG et al. do not disclose any polishing composition that comprises a silica abrasive and has pH 5-7 in the Examples. Outside of the pH range, the polishing rate tends to decrease and the extent of dishing tends to increase (see Figure 2 in the present specification). As described in Example 1 of WANG et al., polishing with a slurry containing an alumina

increases the polishing rate, but gives inferior performance in dishing and erosion as well as causes surface roughness.

TSAI et al. teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, TSAI et al. do not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives" (hereinafter referred to as TZ). The triazole compound is shown as benzotriazole.

TZ and benzotriazole are very different from each other in the polishing rate for slurries that contain each of the compounds. Table 3 of the present specification shows the results of measurements of the polishing and etching rate for polishing slurries each of which contains benzotriazole in place of 1, 2, 4-triazole that is contained in each slurry as shown in Table 1. These results demonstrate that a high polishing rate cannot be obtained with a polishing slurry containing benzotriazole. In contrast, the present slurry containing TZ claimed in this application is capable of polishing a copper-based metal film at a high polishing rate, while preventing dishing from occurring (suppressing etching rate).

Furthermore TSAI et al. do not disclose the claimed content ratio of glycine to TZ (5-8), nor the claimed content of TZ (0.05 - 0.5 wt%). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the

TSAI et al. reference. Therefore, it is very difficult to determine the ratio.

SAKAI et al. teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, SAKAI et al. do not disclose 1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." The triazole compound is shown as benzotriazole. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore SAKAI et al. do not disclose the claimed content ratio of glycine to TZ (5-8), nor the claimed content of TZ (0.05 - 0.5 wt%). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the SAKAI et al. reference. Therefore, it is very difficult to determine the ratio.

ASANO et al. teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, ASANO et al. do not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." The triazole compound is shown as benzotriazole. ASANO et al. disclose only "benzotriazole" in the Examples and disclose that benzotriazole is preferred. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore, ASANO et al. do not disclose the claimed content ratio of glycine to TZ (5-8), nor the claimed content of TZ (0.05 - 0.5 wt%). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the ASANO et al. reference. Therefore, it is very difficult to determine the ratio.

SINHA et al. teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, SINHA et al. do not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." SINHA et al. disclose that benzotriazole is preferred. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore, SINHA et al. do not disclose the claimed content ratio of glycine to TZ (5-8). SINHA et al. disclose many kinds of complexing agents, and that the suitable complexing agents of slurry are not limited to glycine. In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the SINHA et al. reference. Therefore, it is very difficult to determine the ratio.

Taiwanese Patent No. 455626 teaches a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, the Taiwanese patent does not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." The triazole compound is benzotriazole. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore, the Taiwanese patent does not disclose the claimed content ratio of glycine to TZ (5-8). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the Taiwanese patent. Therefore, it is very difficult to determine the ratio.

KAUFMAN et al. ('239) teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, KAUFMAN et al. ('239) do not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." KAUFMAN et al. disclose that benzotriazole is preferred. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore, KAUFMAN et al. ('239) do not disclose the claimed content ratio of glycine to TZ (5-8). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the KAUFMAN et al. reference ('239). Therefore, it is very difficult to determine the ratio.

KAUFMAN et al. ('306) teach a polishing composition that comprises an abrasive, an oxidizing agent, an amino acid and a triazole compound.

However, KAUFMAN et al. ('306) do not disclose "1, 2, 3-triazole, 1, 2, 4-triazole and their derivatives." KAUFMAN et al. disclose that benzotriazole is preferred. A high polishing rate cannot be obtained with a polishing slurry containing benzotriazole as described above.

Furthermore, KAUFMAN et al. ('306) do not disclose glycine nor the claimed content ratio of glycine to TZ (5-8). In addition, no suggestion or motivation exists to connect the ratio to polishing and etching rates in the KAUFMAN et al. ('306) reference. Therefore, it is very difficult to determine the ratio.

From the above remarks, applicants believe that each of the anticipation and obviousness rejections has been traversed. As none of the references taken either individually or in any reasonable combination, either anticipate or render obvious the presently pending claims, allowance of the claims is solicited.

Applicants believe that the present application is in condition for allowance and an early indication of the same is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any

overpayment to Deposit Account No. 25-0120 for any additional
fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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